

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 732 850 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
23.01.2002 Bulletin 2002/04

(51) Int Cl.7: **H04N 7/16**

(21) Application number: **96108778.0**

(22) Date of filing: **12.04.1990**

(54) **Functionally modifiable cable television converter system**

Kabelfernsehkonvertersystem mit modifizierbarer Funktion

Système convertisseur pour télévision par câble fonctionnellement modifiable

(84) Designated Contracting States:
AT BE CH DE DK FR GB IT LI NL SE

(30) Priority: **25.05.1989 US 357174**

(43) Date of publication of application:
18.09.1996 Bulletin 1996/38

(62) Document number(s) of the earlier application(s) in
accordance with Art. 76 EPC:
90107108.4 / 0 399 200

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US-A- 4 710 955

• **SCHNEPERS C: 'Der Schlüssel zum
Scrambling-Problem?' FUNKSCHAU no. 5, 24
February 1989, pages 59 - 62**

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Description

[0001] The present invention relates to cable television apparatus, and more particularly to a converter with remotely modifiable functionality provided by downloadable software.

[0002] Cable television converters are currently available that allow a cable system operator to remotely control subscriber service authorizations from a central "headend" site. These units, which are commonly referred to as "addressable converters", allow the cable system operator to control access to various premium services by sending a control signal from the headend to individual converters located at subscribers' homes. The authorization signals are carried on the cable television system, and enable individual subscribers to view programs that they pay an additional fee for. In operation, the control signals typically enable the converter to descramble the premium channels for viewing by the subscriber.

[0003] Other addressable systems currently available allow a limited set of operational parameters to be downloaded to a converter from the headend. Such operational parameters include, for example, information that maps displayed channels to tuned channels, time-out periods, barker channel(s), the converter output channel, the terminal configuration, and enable/disable functions for subscriber features such as remote hand-held control, parental control, favorite channel recall, volume control, and the like. The current state of the art is to download configuration information for a set of features that have been predetermined at the time of manufacture or installation of the cable television converter. An example of such a converter is the Model DPV7200 addressable converter manufactured by the Jerrold Division of General Instrument Corporation, Hatboro, Pennsylvania, U.S.A.

[0004] Other systems with downloadable data capabilities are also known. U.S. Patent 4,054,911 to Fletcher, et al. relates to an information retrieval system capable of capturing packets or rows of video displayable data and/or control program instructions from data continuously transmitted in a common predetermined format. In the system disclosed in the patent, a user decides what information is to be retrieved, and takes action to cause a terminal to retrieve that information. Although a user can vary the function of the terminal by capturing different transmitted data, it is the user that determines what video displayable information is to be received, and how the terminal which receives this information is to process it. There is no disclosure or provision of means to enable a system operator to establish the functional operation of individual terminals on a multi-terminal network.

[0005] In commonly owned U.S. Patent 4,712,239 to Frezza, et al. entitled "Security Arrangement for Downloadable Cable Television Converters", a converter capable of downloading is disclosed that prevents a false

booter image from being downloaded. A false image could subject the system to various integrity problems, such as enabling an unauthorized user to view premium programs. In the patented system, a booter image is received on one channel and a checksum is computed therefrom. A valid checksum, extracted from tag data transmitted on a separate channel and associated with a scrambled program signal, is compared with the computed checksum. If the checksums do not match, a descrambler in the converter is precluded from descrambling the program signal. The system disclosed in this patent downloads all of the operating software to a cable television converter over a dedicated "booter channel", to which the converter is force tuned when first turned on. After the download is complete, the converter's data receiver is returned to the regular data channel, where it remains until the converter is turned off.

[0006] EP 0 132 401 A2 discloses a system of transmitting information individually and secretly. The information to be transmitted is converted, on the transmission side, in accordance with a predetermined algorithm designated by two keys and then transmitted to a receiving side. The receiving side is supplied with at least two keys from the transmitting side for reproducing the transmitted information by using the two keys. One of the keys is frequently changed so that the algorithm is also changed frequently.

[0007] US 4,710,955 discloses a pay-per-view cable television system that uses a separate telephone line as a secondary communication path.

[0008] In the system, a subscriber terminal includes a tunable converter arranged to receive command data and to download operational parameters forwarded from a headend.

[0009] The article "Der Schlüssel zum Scrambling-Problem?" of Charles Scheper in Funkschau 5/1989, pages 59 to 62 describes an access key for services on a cable system. A control word for accessing one or several services is provided. The control word is used for ordering services.

[0010] GB 2 118 750 A discloses a system for downloading information, software modules and control data to selected terminals in order to provide additional functions such as unscrambling of pay-TV signals, and subscriber interaction signals.

[0011] It would be advantageous to provide a method and system for downloading software to a remote terminal, such as a cable television converter, to allow modification of virtually any or all software functions of the terminal by the system operator. It would be further advantageous for such a method and system to enable the system operator to replace or modify options that were predetermined at the time of manufacture or installation of the terminal. By effecting terminal modifications automatically from a headend location, such a method and system would eliminate the need for a technician to travel to a subscriber's home to modify or physically replace a subscriber's terminal to effect such functional

modifications.

[0012] The present invention provides such a method and system for remotely modifying the functionality of a cable television converter or other terminal.

[0013] In accordance with the present invention a cable television addressable converter with remotely modifiable functionality is provided. The converter comprises frequency agile data receiver means capable of tuning to different carrier frequencies for receipt of addressable converter control data from a cable television headend on a first channel and for receipt of operating software from said headend on a second channel of the distributing cable;

means for tuning said receiver means to said second channel by switching from a carrier frequency of the first channel to a carrier frequency of the second channel for receipt of the operating software in response to instructions contained in said addressable converter control data received on said first channel;

memory means for storing the operating software received on said second channel; and
processor means coupled to said memory means for accessing and executing the operating software received from said headend to provide at least one converter function.

[0014] The converter according to one preferable embodiment includes means for receiving software downloaded over a cable television network, and means coupled to the receiving means for storing the software.

[0015] In another preferable embodiment means are provided for verifying the integrity of the software, and processor means coupled to the storing means accesses and executes the software to provide one or more converter functions dictated by the software.

[0016] In a further preferable embodiment nonvolatile memory means are coupled to the processor means for storing default operation software for the converter.

[0017] In an advantageous embodiment means responsive to the verifying means cause the processor means to execute the default operation software, instead of the downloaded operating software, in the event the integrity of the software is not verified.

[0018] Data receiving means are preferably provided for obtaining instructions downloaded over a cable television network. Downloaded software is received and stored by the converter only in response to specific instructions received by the data receiving means.

[0019] The software receiving means and data receiving means advantageously comprise a frequency agile data receiver, together with means for selectively tuning the receiver, to receive instructions on a first channel and downloaded software on a second channel.

[0020] Timer means return the receiver to the first channel if the receiver has been tuned to the second channel for a predetermined time period. The predeter-

mined time period may be specified in instructions received on said first channel, and the length of the time period may be dependent on an amount of firmware to be received. In this manner, a converter will not become stuck on the second channel by error, and be rendered unable to receive further instructions on the first channel.

[0021] The downloaded software received and stored by the converter can implement a functional layout on a keyboard associated with the converter. Software can also implement a feedback function, such as an LED (light-emitting-diode) display or on-screen display to assist a user in operating the converter. A control function for a video recorder coupled to the converter can also be implemented by the software. Similarly, the software can implement a communication protocol for the converter, a descrambling technique for the converter, an on-screen display to be provided by the converter to a television coupled thereto, and/or a user interface to services provided over the cable television network.

[0022] In a preferred embodiment of the present invention, software is transmitted in an encrypted form, and the instructions contain a key for decrypting the software. The software may also be received by the converter in a plurality of segments, with the instructions identifying the number of segments to be received for a complete software download. Means can be provided of determining if all of the segments have been validly received, and for receiving replacement segments if one or more segments of the software have not been validly received. Receipt of software can be prevented if the number of segments identified by the instructions is greater than a predetermined limit.

[0023] A cable television headend apparatus is provided for downloading operating software to an addressable, remotely modifiable cable television converter. Means are provided for transmitting addressable converter data on a first data channel of a cable television network. Means are provided for transmitting operating software on a second data channel of the cable television network. An address specific to a particular converter is provided in the addressable converter data, which enables specific data to be received by the converter. Instructions are provided in the specific data, to cause the converter to receive software transmitted on the second channel.

[0024] The cable television headend apparatus can further include means for verifying that software downloaded to the converter has been successfully received by the converter. Billing means maintain records of the cable television services each converter on the system is authorized to receive, and the various functions the converter is to have, and can assign a particular software package to be downloaded to a particular converter on the basis of the functions specified for that converter.

[0025] A method for providing a cable television addressable converter with functions dictated by down-

loaded operating software is also provided. Converter addressable control data is received from a remote location via a cable television network. A designated software package is captured from a set of firmware packages carried on the cable television network, in response to instructions contained in the converter control data. The designated software package is stored in a memory provided in the converter, and is executed to provide at least one converter function dictated thereby.

[0026] The software packages may be carried on the cable television network in encrypted form, and decrypted using a key contained in the converter control data. In one embodiment, the converter control data is received on a first data channel and the software packages are captured from a second data channel on the cable television network. The first channel is monitored to receive converter control data, and the second channel is tuned to capture software upon receipt of appropriate instructions on the first channel. Reception is returned to the first channel after the software is captured. If the software has not been captured within a predetermined time period, reception switches back to the first channel from the second channel.

[0027] Also in accordance with the present invention, a remotely modifiable user terminal in the form of a cable television converter is provided which comprises means for receiving a plurality of cyclically transmitted software segments, the segments together comprising a software package. Means coupled to the receiving means verify each segment upon receipt thereof, and means are provided for storing each verified segment. A determination is made as to whether a complete software package has been stored in the storing means at the completion of a software transmission cycle. If not, then reception, verification, and storage of transmitted software segments continues during a subsequent software transmission cycle. Reception of the software segments is terminated upon a finding that a complete software package has been stored. Means can further be provided for precluding the execution of the software segments until a complete software package has been stored.

[0028] The verifying means can operate by testing a checksum for each software segment as it is received. The terminal may further comprise means for maintaining a record of the proper checksum for each segment, and means for periodically retesting the checksums after a complete software package has been stored. Default operation software may be stored for the terminal, and executed if the checksums are not verified upon retesting. The complete software package may also be verified after it has been stored, and the default operation software executed if the complete software package is not valid. The default operation software may also be executed if reception of software segments is not completed during a predetermined time period.

[0029] A complete software package may include a plurality of modules. Execution of fewer than all of the

modules may be precluded as an additional security feature.

[0030] The present invention provides a method and system for downloading software to a remote terminal, such as a cable television converter, to allow modification of virtually any or all software functions of the terminal by the system operator.

[0031] It is further advantageous for such a method and system to enable the system operator to replace or modify options that were predetermined at the time of manufacture or installation of the terminal. By effecting terminal modifications automatically from a headend location, such a method and system eliminates the need for a technician to travel to a subscriber's home to modify or physically replace a subscriber's terminal to effect such functional modifications.

[0032] The present invention provides a method and system for remotely modifying the functionality of a cable television converter or other terminal, which is operable in a nominal or baseline operation mode by downloading specific software to the converter.

[0033] Further features and advantages of the present invention are disclosed in the following description and drawings.

[0034] In the drawings:

Figure 1 is a block diagram of a functionally modifiable cable television converter system in accordance with the present invention;

Figure 3 is a block diagram of the pertinent elements of a converter used in connection with the system of the present invention;

Figure 3 is a flowchart illustrating steps taken by the headend when it receives a new software package or an assignment to download software to a converter;

Figure 4 is a flowchart illustrating the continuous transmission of software over a secondary data channel;

Figure 5 is a flowchart illustrating the steps taken by a converter in receiving downloaded software; and

Figure 6 is a flowchart illustrating the periodic reverification of downloaded software by a converter.

[0035] Turning to Figure 1, a cable television system is depicted having headend components, generally designated 10 and subscriber components, generally designated 12. The headend communicates with the subscriber via a distribution cable 36. A firmware development system 16 is used to create new functional software packages for subscriber terminals, such as converter 40. Software development system 16 may be physically located at the headend, but is more typically located at the facilities of a vendor which develops new software programs for sale to a cable system operator. New software packages may be transferred to an addressable controller 14 located at the headend by mag-

netic tape 20 which is read by addressable controller 14, or by communication between the software development system 16 and addressable controller 14 via direct connection or modems 18 operating over conventional telephone lines. Those skilled in the art will recognize that other means may also be available for transferring software from software development system 16 to addressable controller 14.

[0036] Once software is resident in addressable controller 14, it is transmitted repeatedly over a data channel. The data channel may be either the primary addressable data channel provided in a conventional cable television network having addressable converters, or a separate secondary data channel. In either event, the data channel(s) can transmit the data on an FSK modulated FM carrier or by any other suitable transmission scheme well known in the art.

[0037] The use of a secondary channel for downloading software to converters is illustrated in Figure 1. Control signals, including data such as converter addresses, program authorization codes, and the like is communicated from addressable controller 14 to a converter 40 via control data modulator 26. The output of control data modulator 26 is coupled to distribution cable 36 via a tap 34, and data is received therefrom by converter 40 via tap 38. The control data modulator transmits the data signals on a primary channel, and in accordance with the present invention, the data includes instructions to converter 40 which cause the converter to receive specified software downloaded from addressable controller 14.

[0038] In the two channel embodiment illustrated in Figure 1, the software is transmitted on a secondary channel by software modulator 24, coupled to the cable network at tap 30. Upon receipt of instructions on the primary channel, converter 40 switches to the secondary channel for receipt of designated software. An additional data path 28 may optionally be provided via tap 32 for receipt of data from converter 40 by addressable controller 14. Such data might include, for example, a verification that converter 40 has successfully received a software package it has been instructed to receive. The provision of a return path 28, which provides a "two-way" cable communication system, is well known in the art.

[0039] Billing system 22 is provided at the headend for maintaining accounting information relating to charges incurred by subscribers on the cable system. In accordance with the present invention, different software packages downloaded by headend 10 to converter 40 may provide different converter functions, with higher levels of service providing increased converter functionality. Billing system 22 keeps track of the level of service for each subscriber, and assigns particular software packages to subscriber converters on the basis of converter functionality to be provided to each subscriber.

[0040] At the subscriber location 12, a subscriber may have one or more video appliances 42, 44 coupled to

the output of converter 40. For example, video appliance 42 might be a television set, and video appliance 44 might be a video recorder ("VCR"). In accordance with the present invention, software downloaded to converter 40 can provide functions relating to a VCR. An example of such a function is time controlled programming. This function enables the converter to be programmed to make channel changes at various times so that the VCR can record different television programs on different channels automatically and while unattended. Such a function can also enable "impulse pay-per-view" orders to be programmed into the converter by a subscriber, so that special premium programs can be ordered, when the subscriber is not home, and recorded on the subscriber's VCR for later viewing.

[0041] Figure 2 is a block diagram illustrating the pertinent components in one embodiment of a converter 40 in accordance with the present invention. In the embodiment illustrated, the converter receives addressable data on one data channel and downloaded software on another data channel. It is noted that both the addressable data and the software can also be received over a single data channel. Or, the software may be carried on some other media, such as the public telephone network.

[0042] In the two channel embodiment illustrated in Figure 2, a microprocessor 50 receives data from cable 36 via a frequency agile receiver 52. A transmitter 61 and return path 62 can be provided from microprocessor 50 back to addressable controller 14 in the event the converter is used with a two-way cable television system. Like receiver 52, transmitter 61 can be frequency agile to enable a choice of return transmission frequencies.

[0043] A tuner 54, under the control of microprocessor 50, tunes frequency agile receiver 52 to either a primary channel for receipt of addressable data (e.g., instructions to capture a particular software package) or to a secondary channel for the receipt of software. Although a single secondary channel is described herein for purposes of illustration, it will be appreciated that any number of such secondary channels can be provided, depending on system requirements. Typically, frequency agile receiver will be tuned to the primary channel, and will only switch to the secondary channel upon specific instructions contained in data received on the first channel. In the alternate example where both addressable data and software are received on a single data channel, frequency agile receiver 52 and tuner 54 can be replaced with a fixed frequency data receiver.

[0044] The provision of a dedicated secondary data channel as illustrated in Figure 2 is advantageous. By keeping software data off of the primary channel, the data throughput load on this channel is reduced.

[0045] In the two channel embodiment, software data is broadcast cyclically on the second channel, by addressable controller 14 at the headend. In a preferred embodiment, a plurality of different software packages

are broadcast on the secondary channel, each package providing different converter functions or combinations of functions. Upon receipt of instructions on the primary channel, microprocessor 50 will cause tuner 54 to switch receiver 52 to the secondary channel for receipt of a designated software package.

[0046] Various memory devices are coupled to microprocessor 50, including read only memory ("ROM") 65, operating random access memory ("RAM") 58, and non-volatile RAM 60. ROM 56 contains a program that allows converter 40 to retrieve and execute a downloaded software package. Upon receiving the proper command from the addressable controller, the converter aborts any downloaded package currently being executed, accesses the appropriate data channel for receipt of a designated software package to be downloaded, and receives and loads the software into nonvolatile firmware RAM 60.

[0047] ROM 56 also contains default operation software, which is used to restore the converter to a nominal or "baseline" operation if a bad software download occurs. Such a nominal or "baseline" operation provides the basic functions to a converter, so that watching of at least one television program is possible. These basic functions in particular are predetermined options. As explained below, if an error is detected in the receipt of downloaded software, or if the software is found to be invalid, the converter is forced to execute only the default operation software stored in ROM 56.

[0048] A timer 64 is associated with microprocessor 50 to provide a time-out feature that prevents the converter from getting stuck on the secondary channel, in the event there is a problem receiving specified software.

[0049] When billing system 22 assigns a new software package to a particular converter 40, addressable controller 14 is commanded to transmit instructions to the converter. The instructions are received by microprocessor 50, and include an identifier specifying which software package to receive, where to find the software package (i.e., on the primary or a specified secondary channel), a predetermined time limit defining how long the converter should attempt to receive the software before aborting, a key to use in decrypting the data in the event it is encrypted, and the maximum segment number to be loaded (indicating how many segments are included in the software package to be received). While the software is being received, timer 64 counts down the time-out period specified in the download command. If the timer expires, microprocessor 50 aborts the download, and returns to the original data channel. The time-out period specified in the download command can be varied depending on the amount of software to be downloaded.

[0050] Timer 64 is also used in connection with a self-check that is periodically performed by the converter to ensure that the software has not changed since the last authorized download. This self-check is a security fea-

ture to guard against infiltration of the converter by a "software pirate" who attempts to download unauthorized software to the converter, in an effort to steal services from the cable system.

[0051] In accordance with the self-check procedure, timer 64 retests the checksum for each of the software segments at regular intervals after the software has been downloaded. In the event a checksum is found to be invalid, microprocessor 50 restores the converter to baseline operation by executing the default operation software contained in ROM 56.

[0052] Converter 40 contains various other components with functions that can be modified by downloaded software. For example, a light-emitting-diode ("LED") display or other display 66 may be provided on the converter to give a user feedback concerning converter operations. Pressing a button on the converter, or its remote control unit, can cause an LED to light, verifying that the button has been pressed or that a function to be activated by the button has occurred. Such a feedback function is useful to assist a user in operating the converter.

[0053] The converter also includes a keyboard 68, the functional layout of which can be defined and/or modified by software downloaded to the converter. Keyboard 68 may be physically on the converter box, on a remote hand-held unit for the converter, or a separate keyboard can be provided in both places.

[0054] Converter 40 also includes a descrambler 70 for descrambling premium programs received via the cable television network. Various descrambling techniques are well known in the art, and different techniques can be implemented by downloading different software to the converter.

[0055] Another feature that can be provided by converter 40 is the display of information on a user's television set. On-screen display driver 72 is provided for this purpose. An example of such a display is the channel number tuned to, or the current time. In addition, on-screen displays can be used to distribute messages from the cable system operator, e.g., "your account is past due; please send us a check". An electronic mail, or "E-mail" feature can also be provided, enabling a subscriber to send and receive text messages on his television (or other display) via the cable system. The implementation and/or modification of on-screen displays can be provided by software downloaded to the converter.

[0056] In order to provide a measure of protection against illegal use of the software download feature, the software is downloaded to the converter in an encrypted form. The data is decrypted at the converter by a decryption module 74. A decryption key is transmitted to the converter from the headend as part of the addressable data instructions that command the converter to receive a particular software package. Encryption and decryption schemes are well known in the art. Examples of such schemes are provided in commonly owned U.

S. Patent Nos. 4,638,356 of William A. Frezza, entitled "Apparatus and Method for Restricting Access to a Communication Network", and 4,710,955 of Marc W. Kauffman, entitled "Cable Television System with Two-Way Telephone Communication Path".

[0057] A viewership monitor 76 can be provided in accordance with the present invention to enable a cable system operator to determine what programs and services a subscriber has received using each converter, and/or to retrieve a list of the functions which have been used on each converter. Viewership monitor 76 will monitor the operation of the converter, and store pertinent data relating thereto. By addressing an appropriate command to the converter, the cable system operator will be able to upload the data to the headend for analysis.

[0058] Other functions that can be implemented by software downloaded to the converter include communication protocols for the converter, and user interfaces to services provided over the cable television network. For example, a user may be provided with the capability to order pay-per-view programs on an impulse basis. The procedure for ordering such programs can be modified through downloadable software. Utility meter reading can also be provided, by adding an asynchronous data port to the converter and controlling the retrieval of utility data via downloaded software.

[0059] A flowchart illustrating a routine which can be used by the addressable controller in connection with the receipt and downloading of software is provided in Figure 3. The routine begins at box 80, and at box 82 a determination is made as to whether a software update has been received from the software development system. If so, control passes to box 84 and the new software data is encrypted. At box 86, the encrypted data is loaded into the secondary data channel transmitter (software modulator 24) and continuously transmitted on the secondary channel together with other software packages that can be provided to converters on the system.

[0060] At box 88, a determination is made as to whether a new software package assignment has been made by billing system 22. If so, addressable controller 14 sends an appropriate command on the primary channel (control data modulator 26) as indicated at box 90. The command is addressed to the particular converter that is to receive the software, and identifies the channel the software is to be received from, identifies the software package to be received, provides the decryption key necessary to decrypt the software data, identifies the number of segments which make up the complete software package, and sets forth the time-out parameter defining the maximum time the converter should stay tuned to the secondary channel for receipt of the downloaded software.

[0061] The converter receives the software in fixed length "segments", and specific converter models will have specific maximum segment numbers determining the actual maximum size of allowable software down-

loads. In a preferred embodiment, the maximum segment number is a hard-coded parameter. Should an attempt be made to download software that exceeds the maximum size, the download will be rejected by the converter. In operation, the converter will ignore the download command and will not switch to the secondary channel if the transmitted maximum segment number parameter exceeds the internal converter maximum.

[0062] At box 92 of Figure 3, a determination is made as to whether an abort of a download is required. This would be the case, for example, if the addressable controller detects a problem with an attempted download. In the event an abort is required, an abort command is transmitted over the secondary channel as indicated at box 94. The converter will then switch back to the primary channel, execute the default operation software to return to a baseline operation, and await a subsequent command from the addressable controller via the primary data channel. At box 96, the routine of Figure 3 ends. It will be appreciated by those skilled in the art that the routine of Figure 3 is called on a periodic basis (or can be a continuous loop) to enable new software to be received from the software development system and to download software packages to converters at the command of billing system 22.

[0063] Figure 4 illustrates a routine that the addressable controller can use to continuously transmit firmware data over the secondary channel. The routine commences at box 100, and at box 102 data is transmitted over the secondary channel. At box 104, a determination is made as to whether the last segment of a software package has been transmitted. If not, transmission of the remaining segments continues as indicated at box 102. Once the last segment has been transmitted, control passes to box 106 and the addressable controller transmits a check/execute command to the converter(s) that was to receive the software package. The check/execute command includes the software package number that was to be received, and a check pattern. The check pattern is used to verify the entire download prior to execution. When a check/execute command is received, the converter checks to see if all required segments have been received, and that the check pattern downloaded matches the pattern calculated from the actual downloaded data. If all checks are valid, the converter permits execution of the downloaded code, and returns to the primary data channel. After the check/execute command is sent at box 106 of Figure 4, control returns to box 102, and continuous transmission of the data proceeds over the secondary channel.

[0064] Figure 5 is a flowchart illustrating the capture of downloaded software by a converter. The routine begins at box 110, and control passes to box 112 where a determination is made as to whether a software capture command has been sent to the converter. If not, the converter continuously waits for such a command to be received at box 112.

[0065] Once a software capture command is re-

ceived, control passes from box 112 to box 120 for the actual capture of the software. At the same time, an ancillary time-out process commences as indicated at boxes 114, 116, and 118. A timer counts down the time-out period specified in the software capture command. If the time-out period expires before the specified software package has been successfully captured, as determined at box 114, control passes to box 116 where the download is aborted and the converter returns to the primary data channel. As indicated at box 118, the default operation software is executed so that the converter can operate in a baseline mode until the appropriate software package can be properly downloaded.

[0066] As indicated at box 120, before a software download commences, a determination is made as to whether the number of segments contained in the software package to be downloaded is within bounds. In other words, as noted above, the maximum segment number of the software package to be downloaded must not exceed the maximum size allowable for the converter. If the number of segments exceeds the number allowed by the converter, the software capture command is ignored and control returns to box 112. Otherwise, the software capture proceeds and at box 122, the converter switches to the secondary channel (i.e., the channel on which the firmware is downloaded). At box 124, the segments comprising the software package are received. software is continuously broadcast on the secondary data channel in small (e.g., 32 byte) encrypted packets. A converter that has been commanded to accept a new package tunes to the appropriate channel and loads each packet that has the proper version identifier. While loading, the converter keeps track of each segment successfully loaded in an internal segment bit map. As indicated at box 126, a determination is made as to whether a segment has been successfully loaded. This is accomplished by computing a checksum for each segment, and comparing the checksum with one downloaded with the firmware segment. If the checksums match, the converter decrypts the data contained in the segment, stores the data, and sets an appropriate bit in a software segment bit map as indicated at box 130. In storing the data, if prior software has been stored in the converter, the appropriate segment of the prior software is overwritten with the newly received data.

[0067] If it is determined at box 126 that a segment has not been properly loaded (i.e., the computed and downloaded checksums do not match), the converter ignores the segment and proceeds directly to box 132. At box 132, a determination is made as to whether the last segment in a software package has been received. If not, control returns to box 124 and the procedure continues until all segments are received.

[0068] After the last segment has been received, control passes to box 134 which determines if the bit map created at box 130 is complete. If the bit map is not complete, it means that one or more segments were not properly loaded and an attempt to receive these seg-

ments will be made during the next transmission cycle of the software. In this event, control returns from box 132 to box 124 where an attempt to receive the entire firmware package will again be made.

[0069] As is evident from the flowchart of Figure 5, an incorrectly received segment will not overwrite a previously correctly received segment. All correctly received segments, however, will overwrite previously received segments. In this manner, even if there are errors in the transmission of certain segments during a download cycle, all of the segments should be correctly received after the completion of several complete transmission cycles of a software package.

[0070] Once all of the segments have been properly received, the bit map will be complete, and box 134 will pass control to box 136. Box 136 responds to the check/execute command transmitted by the addressable controller at box 106 in Figure 4. When the check/execute command is received, the converter checks to see if all required segments have been received and that the check pattern downloaded matches a pattern calculated from the actual downloaded data (i.e., the complete software package). If the patterns do not match, control returns to box 124 and additional attempts are made to receive the software as long as a time-out (box 114) has not occurred.

[0071] If the entire software package is determined to be valid at box 136, control passes to box 138 and an execution bit is set permitting the software to be executed. As an additional level of protection against a software pirate, software contained in the converter's ROM (ROM 56 - Figure 2) can periodically determine if all of the functional modules contained in the software package are being executed, and if not, subsequent execution of the software can be precluded by turning off a separate, special execution bit maintained by the converter.

[0072] At box 140, the downloading of a software package is complete, and the converter returns to the primary data channel. The routine ends at box 142.

[0073] The software download process is a destructive one. Once a converter receives the command to accept a new package, the old downloaded software (if any) is effectively deleted and cannot be executed. In the preferred embodiment, partial downloads are not supported, and an entire package must be sent. This further frustrates a software pirate's efforts, and allows a software download to be nullified by sending the command to accept a package immediately followed by sending the command to return to the primary data channel.

[0074] The various commands sent by the addressable controller to support the firmware download process are:

Accept Software Download
Return to Primary Channel
Disallow Downloaded Execution

Load Software Segment
Check/Execute Software
Send Software Check Pattern

[0075] The "Accept Software Download" command is used to initiate the software download process. It may be sent to one individual converter or globally to a set of converters that understand a group address. The addressed converter(s) prepares to accept the package number, on the appropriate channel, using the given firmware decryption key and maximum segment number. The software download time-out value is also given. Upon reception of this command, the converter goes into its software download mode, in which it must not execute any downloaded code.

[0076] The "Return to Primary Channel" command is used to force a converter to return to the primary data channel. This command may also be sent in a specific format to an individual converter, or in group format to a set of converters. All converters receiving this command abort the current software download, clear their software segment bit maps, and exit the software download mode.

[0077] The "Disallow Downloaded Execution" command explicitly disallows the execution of any downloaded software. It may be sent in the specific or group format. All converters receiving this command abort execution of any downloaded software, clear their software segment bit maps, exit software download mode, and execute the default operation software contained in ROM for baseline operation. Another method of prohibiting downloaded software from being executed is to send an "Accept software Download" command immediately followed by a "Return to Primary Channel" command.

[0078] The "Load Software Segment" command is used to download the individual segments of a software package. All converters receiving this command, if in software reception mode, overwrite the appropriate segment of software by the received data. Before actually overwriting the code, the converter checks to see if the package number matches the commanded package number, and calculates the segment check pattern from the received data. If the check pattern is correct, the segment data is decrypted, the appropriate prior segment is overwritten with the new segment, and the appropriate bit in the software segment bit map is set.

[0079] The "Check/Execute Software" command is used to terminate the software download process. All converters receiving this command respond only if the package number matches the one sent originally in the "Accept Software Download" command, and if in software reception mode. If so, the converter checks to see if all of the necessary segments of software have been correctly received. If they have been, the package check pattern is calculated and tested. If the check pattern is bad, the converter ignores the command. If the check pattern is good, the converter permits execution of the

newly downloaded package, switches back to the primary data stream, exits the software download mode, and clears its software download segment bit map.

[0080] The "Send Software Check Pattern" command is used to verify the software download process. A converter receiving this command responds only if it is not in software reception mode. In this event, the converter reports the check pattern of the appropriate segment or of the entire package. This verification scheme is only available on a two-way cable system.

[0081] Figure 6 illustrates a periodic self-check routine used by the converter to test the validity of downloaded software to ensure that it has not changed since the last download. This self-check is performed by the converter itself, and no addressable controller command is required to initiate it. The routine begins at box 150. At box 152, a clock runs to keep track of time. At box 154, a determination is made as to whether a predetermined time interval has passed. If not, the routine loops back to box 152 and the process continues until the time interval has run. Then, box 154 passes control to box 156 to commence the periodic self-check.

[0082] At box 156, the first segment of the software package is tested by computing its checksum. At box 158, a determination is made as to whether the checksum is the proper checksum for that segment. If not, control passes to box 160 and the default operation software is executed to return the converter to baseline operation. If the checksum for the segment is proper, control passes to box 162, which determines if the segment just tested is the last segment in the software package. If not, the routine loops back to box 156 so that all of the segments in the software package can be tested.

[0083] Once the last segment has been tested, control is passed from box 162 to box 164 where the clock is reset. Control then loops back to box 152 and the process continues, so that the self-check will be periodically performed at the time interval dictated by the time-out determination function at box 154.

[0084] It will now be appreciated that the present invention provides a method and apparatus for remotely modifying the functionality of a terminal, such as a cable television converter. Terminal functions are dictated by downloaded software. The software is transmitted in small segments to reduce the likelihood and severity of transmission errors, and to reduce the temporary buffering requirements within the terminal. Each section of a software package is transmitted with an identifier indicating which segment it is, and which software package it is part of. A multiplicity of software packages may be carried on a single system, with different terminals in the system accepting and executing different packages as specified by the system headend.

[0085] The software is stored at the terminal in non-volatile memory, such as RAM with a battery backup. Various safeguards are provided to ensure that the software is accurately downloaded, and to frustrate the efforts of a software pirate attempting to infiltrate the sys-

tem.

[0086] Although the present invention has been described in connection with a preferred embodiment, it will be appreciated that many modifications and adaptations may be made thereto without departing from the scope of the invention as set forth in the following claims.

Claims

1. A cable television addressable converter with remotely modifiable functionality comprising:

frequency agile data receiver means (52) capable of tuning to different carrier frequencies for receipt of addressable converter control data from a cable television headend (10) on a first channel of a distribution cable (36) and for receipt of operating software from said headend on a second channel of the distribution cable (36);

means (54) for tuning said receiver means (52) to said second channel by switching from a carrier frequency of the first channel to a carrier frequency of the second channel for receipt of the operating software in response to instructions contained in said addressable converter control data received on said first channel; memory means (60) for storing the operating software received on said second channel; and processor means (50) coupled to said memory means (60) for accessing and executing the operating software received from said headend (10) to provide at least one converter function.

2. The converter of claim 1 further comprising:

means for verifying the integrity of said operating software received on said second channel; and

means for causing said processor means to execute default operation software instead of said operating software in the event the integrity of said operating software is not verified.

3. The converter as defined in one of claims 1 or 2 further comprising:

timer means for returning said receiver to said first channel if it has been tuned to said second channel for a predetermined time period.

4. The converter of claim 3 wherein said predetermined time period is specified in instructions contained in said addressable converter control data received on said first channel.

5. The converter as defined in one of claims 3 or 4 wherein the length of said predetermined time pe-

riod is dependent on the amount of said operating software to be received.

6. The converter as defined in one of claims 1 to 5 wherein said operating software implements a functional layout of a keyboard associated with said converter.

7. The converter as defined in one of claims 1 to 6 wherein said operating software implements a feedback function to assist a user in operating the converter.

8. The converter as defined in one of claims 1 to 7 wherein said operating software implements a control function for a video recorder coupled to the converter.

9. The converter as defined in one of claims 1 to 8 wherein said operating software implements a communication protocol for the converter.

10. The converter as defined in one of claims 1 to 9 wherein said operating software implements a descrambling technique for the converter.

11. The converter as defined in one of claims 1 to 10 wherein said operating software implements an on-screen display to be provided by the converter to a television coupled thereto.

12. The converter as defined in one of claims 1 to 11 wherein said operating software implements a user interface to services provided over a cable television network.

13. The converter as defined in one of claims 1 to 12 wherein said operating software implements an electronic mail capability to be provided over a cable television network.

14. The converter as defined in one of claims 1 to 13 wherein said operating software implements a viewership monitoring function.

15. The converter as defined in one of claims 1 to 14 further comprising:

means for enabling the downloaded operating software to be received and stored by the converter only in response to specific instructions received by said data receiving means.

16. The converter as defined in one of claims 1 to 15 wherein said operating software is transmitted in an encrypted form, and said instructions contain a key for decrypting the operating software.

17. The converter as defined in one of claims 1 to 16

wherein said operating software is received in a plurality of segments, and said instructions identify the number of segments to be received for a complete operating software download.

18. The converter of claim 17 further comprising:

means for determining if all of said segments have been validly received; and
means for receiving replacement segments if one or more segments of said operating software has not been validly received.

19. The converter as defined in one of claims 17 or 18 further comprising:

means for preventing the receipt of said operating software if the number of segments identified by said instructions is greater than a predetermined limit.

20. Cable television headend apparatus for downloading operating software to an addressable remotely modifiable cable television converter (40), comprising:

means (26) for transmitting addressable converter control data on a carrier frequency of a first data channel of a distribution cable (36) of a cable television network;

means (24) for transmitting operating software on a carrier frequency of a second data channel of the distribution cable (36) of said cable television network;

means (14) for providing an address in said addressable converter control data specific to a particular converter (40) coupled to the network, said address enabling specific data to be received by said converter (40) on said first data channel; and

means (50) for providing instructions in said specific data, said instructions causing said converter to switch from said carrier frequency of said first channel to said carrier frequency of said second channel to receive the operating software transmitted on said second channel.

21. The apparatus of claim 20 further comprising:

means for verifying that operating software downloaded to said converter has been successfully received by the converter.

22. The apparatus as defined in one of claims 20 or 21 further comprising:

billing means for maintaining a record of functions said converter is authorized to have, and for assigning a particular operating software package to be downloaded to said converter on the basis of the authorized functions.

23. A method for providing a cable television addressable converter with functions dictated by downloaded operating software, comprising the steps of:

receiving addressable converter control data from a remote headend location on a first channel of a distribution cable;

switching data receiver means (52) from a carrier frequency of said first channel to a carrier frequency of a second channel in response to instructions contained in said addressable converter control data;

capturing a designated operating software package, from a set of operating software packages transmitted from said remote headend location on said second channel of the distribution cable, in response to instructions contained in said addressable converter control data;

storing the designated operating software package received on said second channel in a memory provided in said converter; and
executing said operating software to provide at least one converter function dictated thereby.

24. The method of claim 23 wherein the operating software packages are transmitted in encrypted form, said method comprising the further step of:

decrypting the captured operating software using a key contained in said converter control data.

25. The method of claim 23 or 24 comprising the further steps of:

monitoring said first channel to receive said addressable converter control data;

switching to said second channel to capture said operating software upon receipt of appropriate instructions on said first channel; and
switching back to said first channel after said operating software is captured.

26. The method of claim 25 comprising the further step of:

switching back to said first channel from said second channel upon the expiration of a predetermined time period, if the operating software has not been captured within said time period.

27. The method of claim 26 comprising the further step of:

deriving said time period from said addressable converter control data received on said first channel.

28. The method as defined in one of claims 26 or 27 wherein the length of the time period is dependent on the amount of said operating software to be cap-

tured.

29. A remotely modifiable user terminal in the form of a cable television converter according to one of the claims 1 to 19, said user terminal comprising:

means for receiving a plurality of cyclically transmitted operating software segments together forming an operating software package; means coupled to said receiving means for verifying each segment upon receipt thereof; means responsive to said verifying means for storing each verified segment; means for determining if a complete operating software package has been stored in said storing means at the completion of an operating software transmission cycle; means responsive to said determining means for continuing to receive, verify, and store transmitted operating software segments during a subsequent operating software transmission cycle if said determining means finds that a complete operating software package has not been stored; and means for terminating the reception of said operating software segments upon a finding by said determining means that a complete operating software package has been stored.

30. The terminal of claim 29 further comprising:
means for precluding the execution of said operating software segments until a complete operating software package has been stored.

31. The terminal as defined in one of claims 29 or 30 wherein said verifying means tests a checksum for each operating software segment, said terminal further comprising:

means for maintaining a record of the proper checksum for each segment; and means for periodically retesting said checksums after a complete operating software package has been stored.

32. The terminal of claim 31 further comprising:

means for storing default operation software for said terminal; and means for executing said default operation software if said checksums are not verified upon retesting.

33. The terminal as defined in one of claims 29 to 32 further comprising:

means for validating the complete operating software package after it has been stored.

34. The terminal of claim 33 further comprising:

means for storing default operation software for said terminal; and means for executing said default operation software if said validating means determines that the complete operating software package is not valid.

35. The terminal as defined in one of claims 29 to 34 further comprising:

timer means for terminating the reception of operating software segments after a predetermined time period.

36. The terminal of claim 35 further comprising:

means for storing default operation software for said terminal; and means for executing said default operation software if said timer means terminates the reception of said operating software segments.

37. The terminal as defined in one of claims 29 to 36 wherein the execution of said operating software provides at least one converter function of the cable television converter.

38. The terminal as defined in one of claims 29 to 37 wherein a complete operating software package includes a plurality of modules, said terminal further comprising:

means for precluding the execution of downloaded operating software if fewer than all of the modules are available for execution.

39. Method for providing downloaded operating software to an addressable remotely modifiable cable television converter by a cable television headend apparatus, comprising the steps of:

transmitting addressable converter control data on a carrier frequency of a first data channel of a distribution cable of a cable television network;
transmitting said operating software on a carrier frequency of a second data channel of the distribution cable of said cable television network;
providing an address in said addressable converter control data specific to a particular converter coupled to the network, said address enabling specific data to be received by said converter on said first data channel; and providing instructions in said specific data, said instructions causing said converter to switch from said carrier frequency of said first channel to said carrier frequency of said second chan-

nel to receive said operating software transmitted on said second channel.

baren Konvertersteuerdaten, welche auf dem ersten Kanal empfangen werden, enthalten sind, spezifiziert wird.

Patentansprüche

1. Ein adressierbarer Kabelfernsehkonzert mit fern-modifizierbarer Funktion, bestehend aus:

einem frequenzagilen Datenempfangsmittel (52), das sich auf verschiedene Trägerfrequenzen zum Empfang adressierbarer Konvertersteuerdaten von einer Kabelfernsehkopfstele (10) auf einem ersten Kanal eines Verteilerkabels (36) und zum Empfang von Betriebssoftware von der Kopfstele auf einem zweiten Kanal des Verteilerkabels (36) abstimmen kann;

einem Mittel (54) zum Abstimmen des Empfangsmittels (52) auf einen zweiten Kanal durch das Schalten von einer Trägerfrequenz des ersten Kanals auf eine Trägerfrequenz des zweiten Kanals zum Empfang der Betriebssoftware als Antwort auf in den adressierbaren Konvertersteuerdaten, welche auf dem ersten Kanal empfangen werden, enthaltene Befehle;

einem Speichermittel (60) zum Speichern der auf dem zweiten Kanal empfangenen Betriebssoftware; und

einem Prozessormittel (50), das mit dem Speichermittel (60) verbunden ist, zum Zugreifen auf und Ausführen der von der Kopfstele (10) empfangenen Betriebssoftware, um mindestens eine Konverterfunktion bereitzustellen.

2. Konverter gemäß Anspruch 1, ferner bestehend aus:

einem Mittel zum Feststellen der Integrität der auf dem zweiten Kanal empfangenen Betriebssoftware; und

einem Mittel zum Bewirken, daß das Prozessormittel anstatt der Betriebssoftware eine Standardfunktionssoftware ausführt, wenn die Integrität der Betriebssoftware nicht festgestellt wird.

3. Konverter gemäß einem der Ansprüche 1 oder 2, ferner bestehend aus:

einem Zeitgebemittel zum Zurückstellen des Empfängers auf den ersten Kanal, wenn er über einen vorgegebenen Zeitraum auf den zweiten Kanal abgestimmt gewesen ist.

4. Konverter gemäß Anspruch 3, wobei der vorgegebene Zeitraum in Befehlen, die in den adressier-

5. Konverter gemäß einem der Ansprüche 3 oder 4, wobei die Länge des vorgegebenen Zeitraums von dem Umfang der zu empfangenden Betriebssoftware abhängig ist.

6. Konverter gemäß einem der Ansprüche 1 bis 5, wobei die Betriebssoftware eine Funktionskonfiguration einer mit dem Konverter verbundenen Tastatur implementiert.

7. Konverter gemäß einem der Ansprüche 1 bis 6, wobei die Betriebssoftware eine Rückkopplungsfunktion implementiert, um einem Verwender beim Betätigen des Konverters zu helfen.

8. Konverter gemäß einem der Ansprüche 1 bis 7, wobei die Betriebssoftware eine Steuerungsfunktion für einen mit dem Konverter verbundenen Videorekorder implementiert.

9. Konverter gemäß einem der Ansprüche 1 bis 8, wobei die Betriebssoftware ein Kommunikationsprotokoll für den Konverter implementiert.

10. Konverter gemäß einem der Ansprüche 1 bis 9, wobei die Betriebssoftware ein Entwurfverfahren für den Konverter implementiert.

11. Konverter gemäß einem der Ansprüche 1 bis 10, wobei die Betriebssoftware eine Anzeige auf dem Bildschirm implementiert, die von dem Konverter an einen damit verbundenen Fernseher bereitzustellen ist.

12. Konverter gemäß einem der Ansprüche 1 bis 11, wobei die Betriebssoftware eine Benutzeroberfläche zu über ein Kabelfernsehnzwerk bereitgestellten Dienstleistungen implementiert.

13. Konverter gemäß einem der Ansprüche 1 bis 12, wobei die Betriebssoftware eine Fähigkeit für elektronischen Briefdienst implementiert, die über ein Kabelfernsehnzwerk bereitzustellen ist.

14. Konverter gemäß einem der Ansprüche 1 bis 13, wobei die Betriebssoftware eine Zuschauerüberwachungsfunktion implementiert.

15. Konverter gemäß einem der Ansprüche 1 oder 14, ferner bestehend aus:

einem Mittel zum Ermöglichen, daß die heruntergeladene Betriebssoftware nur als Antwort auf spezifische vom Datenempfangsmittel

empfangene Befehle vom Konverter empfangen und gespeichert werden.

16. Konverter gemäß einem der Ansprüche 1 bis 15, wobei die Betriebssoftware in verschlüsselter Form übertragen wird und die Befehle einen Schlüssel enthalten, um die Betriebssoftware zu entschlüsseln. 5
17. Konverter gemäß einem der Ansprüche 1 bis 16, wobei die Betriebssoftware in einer Vielzahl von Segmenten empfangen wird und die Befehle die Anzahl der für eine vollständige Herunterladung der Betriebssoftware zu empfangenden Segmente identifizieren. 10 15
18. Konverter gemäß Anspruch 17, ferner bestehend aus:
- einem Mittel zum Bestimmen, ob alle Segmente richtig empfangen worden sind; und 20
- einem Mittel zum Empfangen von Ersatzsegmenten, wenn ein oder mehrere Segmente der Betriebssoftware nicht richtig empfangen worden sind. 25
19. Konverter gemäß einem der Ansprüche 17 oder 18, ferner bestehend aus: 30
- einem Mittel zum Verhindern des Empfangs der Betriebssoftware, wenn die Anzahl der von den Befehlen identifizierten Segmente größer als eine vorgegebene Grenze ist. 35
20. Kabelfernsehkopfstellenvorrichtung zum Herunterladen von Betriebssoftware auf einen adressierbaren, fernmodifizierbaren Kabelfernsehkonverter (40), bestehend aus: 40
- einem Mittel (26) zum Übertragen adressierbarer Konvertersteuerdaten auf einer Trägerfrequenz eines ersten Datenkanals eines Verteilerkabels (36) eines Kabelfernsehnetzwerks; 45
- einem Mittel (24) zum Übertragen von Betriebssoftware auf einer Trägerfrequenz eines zweiten Datenkanals des Verteilerkabels (36) des Kabelfernsehnetzwerks; 50
- einem Mittel (14) zum Bereitstellen einer Adresse in den adressierbaren Konvertersteuerdaten, die spezifisch für einen einzelnen adressierbaren, mit dem Netzwerk verbundenen Konverter (40) ist, wobei die Adresse ermöglicht, daß spezifische Daten vom Konverter (40) auf dem ersten Datenkanal empfangen werden; und 55

einem Mittel (50) zum Bereitstellen von Befehlen in den spezifischen Daten, wobei die Befehle bewirken, daß der Konverter von der Trägerfrequenz des ersten Kanals auf die Trägerfrequenz des zweiten Kanals schaltet, um die auf dem zweiten Kanal übertragene Betriebssoftware zu empfangen.

21. Vorrichtung gemäß Anspruch 20, ferner bestehend aus:

einem Mittel zum Feststellen, daß auf den Konverter heruntergeladene Betriebssoftware erfolgreich vom Konverter empfangen worden ist.

22. Vorrichtung gemäß einem der Ansprüche 20 oder 21, ferner bestehend aus:

einem Fakturierungsmittel zum Festhalten der Funktionen, die der Konverter aufweisen darf, und zum Zuordnen eines besonderen Betriebssoftware-Pakets, das auf der Basis der berechtigten Funktionen auf den Konverter herunterzuladen ist.

23. Ein Verfahren zum Bereitstellen eines adressierbaren Kabelfernsehkonverters mit von der heruntergeladenen Betriebssoftware diktierten Funktionen, bestehend aus folgenden Schritten:

Empfangen adressierbarer Konvertersteuerdaten von einer abgesetzten Kopfstellenvorrichtung auf einem ersten Kanal eines Verteilerkabels;

Schalten des Datenempfangsmittels (52) von einer Trägerfrequenz des ersten Kanals auf eine Trägerfrequenz des zweiten Kanals als Antwort auf in den adressierbaren Konvertersteuerdaten enthaltene Befehle;

Festhalten eines bestimmten Betriebssoftware-Pakets aus einem Satz von Betriebssoftware-Paketen, welche von dem abgesetzten Kopfstellenvorrichtung auf dem zweiten Kanal des Verteilerkabels übertragen werden, in Antwort auf in den adressierbaren Konvertersteuerdaten enthaltene Befehle;

Speichern des bestimmten, auf dem zweiten Kanal empfangenen Betriebssoftware-Pakets in einem in dem Konverter bereitgestellten Speicher; und

Ausführen der Betriebssoftware, um mindestens eine dadurch diktierte Konverterfunktion bereitzustellen.

24. Verfahren gemäß Anspruch 23, wobei die Betriebs-

software-Pakete in verschlüsselter Form übertragen werden, wobei das Verfahren aus folgendem Schritt besteht:

Entschlüsseln der festgehaltene Betriebssoftware unter Verwendung eines in den Konvertersteuerdaten enthaltenen Schlüssels. 5

25. Verfahren gemäß Anspruch 23 oder 24, ferner bestehend aus folgenden Schritten: 10

Überwachen des ersten Kanals, um adressierbare Konvertersteuerdaten zu empfangen;

Schalten auf den zweiten Kanal, um Betriebssoftware beim Empfang geeigneter Befehle auf dem ersten Kanal festzuhalten; und 15

Zurückschalten auf den ersten Kanal, nachdem die Betriebssoftware festgehalten worden ist. 20

26. Verfahren gemäß Anspruch 25, ferner bestehend aus folgendem Schritt:

Zurückschalten von dem zweiten Kanal auf den ersten Kanal nach Ablauf eines vorgegebenen Zeitraums, wenn die Betriebssoftware innerhalb des Zeitraums nicht festgehalten worden ist. 25

27. Verfahren gemäß Anspruch 26, ferner bestehend aus folgendem Schritt: 30

Ermitteln des Zeitraums aus den auf dem ersten Kanal empfangenen adressierbaren Konvertersteuerdaten. 35

28. Verfahren gemäß einem der Ansprüche 26 oder 27, wobei die Länge des Zeitraums von der Menge der festzuhaltenden Betriebssoftware abhängig ist. 40

29. Eine fernmodifizierbare Benutzerstation in der Form eines Kabelfernsehkonverters gemäß einem der Ansprüche 1 bis 19, wobei die Benutzerstation aus folgendem besteht: 45

einem Mittel zum Empfangen einer Vielzahl von zyklisch übertragenen Betriebssoftwaresegmenten, die gemeinsam ein Betriebssoftware-Paket bilden;

einem mit dem Empfangsmittel verbundenen Mittel zum Feststellen jedes Segments bei dessen Empfang;

einem Mittel, das zum Speichern jedes festgestellten Segments auf das Feststellungsmittel anspricht; 50

einem Mittel zum Bestimmen, ob ein vollständiges Betriebssoftware-Paket in dem Speichermedium beim Abschluß eines Betriebssoftware-Übertragungszyklus gespeichert worden ist;

einem Mittel, das auf das Bestimmungsmittel anspricht, zum weiteren Empfangen, Feststellen und Speichern übertragener Betriebssoftware-Segmente während eines nachfolgenden Betriebssoftware-Übertragungszyklus, wenn das Bestimmungsmittel erkennt, daß ein vollständiges Betriebssoftware-Paket nicht gespeichert worden ist; und

einem Mittel zum Beenden des Empfangs der Betriebssoftware-Segmente, wenn das Bestimmungsmittel erkennt, daß ein vollständiges Betriebssoftware-Paket gespeichert worden ist.

30. Station gemäß Anspruch 29, ferner bestehend aus:

einem Mittel zum Verhindern des Ausführens der Betriebssoftware-Segmente bis ein vollständiges Betriebssoftware-Paket gespeichert wird.

31. Station gemäß einem der Ansprüche 29 oder 30, wobei das Feststellungsmittel eine Prüfsumme für jedes Betriebssoftware-Segment prüft, wobei die Station ferner aus folgendem besteht:

einem Mittel zum Festhalten der richtigen Prüfsumme für jedes Segment; und

einem Mittel zum periodischen Wiederprüfen der Prüfsummen nachdem ein vollständiges Betriebssoftware-Paket gespeichert worden ist.

32. Station gemäß Anspruch 31, ferner bestehend aus:

einem Mittel zum Speichern von Standardfunktionssoftware für jede Station; und

einem Mittel zum Ausführen der Standardfunktionssoftware, wenn die Prüfsummen beim Wiederprüfen nicht festgestellt werden.

33. Station gemäß einem der Ansprüche 29 bis 32, ferner bestehend aus:

einem Mittel zum Feststellen des vollständigen Betriebssoftware-Pakets nachdem es gespeichert worden ist.

34. Station gemäß Anspruch 33, ferner bestehend aus:

einem Mittel zum Speichern von Standardfunktionssoftware für die Station; und

einem Mittel zum Ausführen der Standardfunktionssoftware, wenn das Feststellungsmittel bestimmt, daß das vollständige Betriebssoftware-Paket nicht gültig ist. 5

35. Station gemäß einem der Ansprüche 29 bis 34, ferner bestehend aus: 10

einem Zeitgebemittel zum Beenden des Empfangs von Betriebssoftware-Segmenten nach einem vorgegebenen Zeitraum.

36. Station gemäß Anspruch 35, ferner bestehend aus:

einem Mittel zum Speichern von Standardfunktionssoftware für jede Station; und

einem Mittel zum Ausführen der Standardfunktionssoftware, wenn das Zeitgebemittel das Empfangen der Betriebssoftware-Segmente beendet. 20

37. Station gemäß einem der Ansprüche 29 bis 36, wobei das Ausführen der Betriebssoftware mindestens eine Konverterfunktion des Kabelfernsehkonzerters bereitstellt. 25

38. Station gemäß einem der Ansprüche 29 bis 37, wobei ein vollständiges Betriebssoftware-Paket eine Vielzahl von Funktionseinheiten beinhaltet, wobei die Station ferner aus folgendem besteht: 30

einem Mittel zum Verhindern des Ausführens heruntergeladener Betriebssoftware, wenn weniger als alle Funktionseinheiten zum Ausführen vorhanden sind. 35

39. Ein Verfahren zum Bereitstellen heruntergeladener Betriebssoftware für einen adressierbaren, fernmodifizierbaren Kabelfernsehkonzerters durch eine Kabelfernsehkopfstellenvorrichtung, bestehend aus folgenden Schritten: 40

Übertragen adressierbarer Konvertersteuerdaten auf einer Trägerfrequenz eines ersten Datenkanals eines Verteilerkabels eines Kabelfernsehnzwerks; 45

Übertragen der Betriebssoftware auf einer Trägerfrequenz eines zweiten Datenkanals des Verteilerkabels des Kabelfernsehnzwerks; 50

Bereitstellen einer Adresse in den adressierbaren Konvertersteuerdaten, die spezifisch für einen einzelnen mit dem Netzwerk verbundenen 55

Konverter ist, wobei die Adresse ermöglicht, daß spezifische Daten vom Konverter auf dem ersten Datenkanal empfangen werden; und

Bereitstellen von Befehlen in den spezifischen Daten, wobei die Befehle bewirken, daß der Konverter von der Trägerfrequenz des ersten Kanals auf die Trägerfrequenz des zweiten Kanals schaltet, um die auf dem zweiten Kanal übertragene Betriebssoftware zu empfangen.

Revendications

1. Un convertisseur adressable de télévision par câble à fonctionnalité modifiable à distance comprenant :

un moyen récepteur de données agile en fréquence (52) capable de s'accorder sur différentes fréquences porteuses pour recevoir des données de contrôle de convertisseur adressable depuis une tête de réseau de télévision par câble (10) sur une première voie de transmission d'un câble de distribution (36) et pour recevoir un logiciel d'exploitation depuis ladite tête de réseau sur une seconde voie de transmission du câble de distribution (36) ;

un moyen (54) pour accorder ledit moyen récepteur (52) sur ladite seconde voie de transmission en commutant d'une fréquence porteuse de la première voie de transmission sur une fréquence porteuse de la seconde voie de transmission pour recevoir le logiciel d'exploitation en réponse à des instructions contenues dans lesdites données de contrôle de convertisseur adressable reçues sur ladite première voie de transmission ;

un moyen mémoire (60) pour mémoriser le logiciel d'exploitation reçu sur ladite seconde voie de transmission ; et

un moyen processeur (50) couplé audit moyen mémoire (60) pour accéder au logiciel d'exploitation reçu depuis ladite tête de réseau (10) et l'exécuter afin de fournir au moins une fonction de convertisseur.

2. Le convertisseur de la revendication 1 comprenant de plus :

un moyen pour vérifier l'intégrité dudit logiciel d'exploitation reçu sur ladite seconde voie de transmission ; et

un moyen pour amener ledit moyen processeur à exécuter le logiciel d'exploitation par défaut à

la place dudit logiciel d'exploitation au cas où l'intégrité dudit logiciel d'exploitation ne se serait pas vérifiée.

3. Le convertisseur tel que défini dans l'une des revendications 1 ou 2 comprenant de plus :
un moyen minuteur pour renvoyer ledit récepteur sur ladite première voie de transmission s'il a été accordé sur ladite seconde voie de transmission pendant un laps de temps prédéterminé. 5
4. Le convertisseur de la revendication 3 dans lequel ledit laps de temps prédéterminé est spécifié dans des instructions contenues dans lesdites données de contrôle de convertisseur adressable reçues sur ladite première voie de transmission. 10
5. Le convertisseur tel que défini dans l'une des revendications 3 ou 4 dans lequel la durée dudit laps de temps prédéterminé est fonction de la taille dudit logiciel d'exploitation devant être reçu. 15
6. Le convertisseur tel que défini dans l'une des revendications 1 à 5 dans lequel ledit logiciel d'exploitation implémente une disposition fonctionnelle des touches de clavier associée audit convertisseur. 20
7. Le convertisseur tel que défini dans l'une des revendications 1 à 6 dans lequel ledit logiciel d'exploitation implémente une fonction de rétroaction pour aider un utilisateur à faire fonctionner le convertisseur. 25
8. Le convertisseur tel que défini dans l'une des revendications 1 à 7 dans lequel ledit logiciel d'exploitation implémente une fonction de contrôle pour un magnétoscope couplé au convertisseur. 30
9. Le convertisseur tel que défini dans l'une des revendications 1 à 8 dans lequel ledit logiciel d'exploitation implémente un protocole de communication pour le convertisseur. 35
10. Le convertisseur tel que défini dans l'une des revendications 1 à 9 dans lequel ledit logiciel d'exploitation implémente une technique de désembrouillage pour le convertisseur. 40
11. Le convertisseur tel que défini dans l'une des revendications 1 à 10 dans lequel ledit logiciel d'exploitation implémente un affichage à l'écran devant être fourni par le convertisseur à une télévision à laquelle il est couplé. 45
12. Le convertisseur tel que défini dans l'une des revendications 1 à 11 dans lequel ledit logiciel d'exploitation implémente une interface utilisateur pour des services fournis sur un réseau de télévision par 50

câble.

13. Le convertisseur tel que défini dans l'une des revendications 1 à 12 dans lequel ledit logiciel d'exploitation implémente une fonction courrier électronique devant être fournie sur un réseau de télévision par câble. 5
14. Le convertisseur tel que défini dans l'une des revendications 1 à 13 dans lequel ledit logiciel d'exploitation implémente une fonction de surveillance de l'audience. 10
15. Le convertisseur tel que défini dans l'une des revendications 1 à 14 comprenant de plus :
un moyen pour autoriser la réception et la mémorisation, par le convertisseur, du logiciel d'exploitation téléchargé uniquement en réponse à des instructions spécifiques reçues par ledit moyen récepteur de données. 15
16. Le convertisseur tel que défini dans l'une des revendications 1 à 15 dans lequel ledit logiciel d'exploitation est transmis sous une forme encryptée et lesdites instructions contiennent une clé pour décrypter le logiciel d'exploitation. 20
17. Le convertisseur tel que défini dans l'une des revendications 1 à 16 dans lequel ledit logiciel d'exploitation est reçu en une pluralité de segments et lesdites instructions identifient le nombre de segments devant être reçus pour un téléchargement du logiciel d'exploitation au complet. 25
18. Le convertisseur de la revendication 17 comprenant de plus :
un moyen pour déterminer si lesdits segments ont tous été reçus de façon valide ; et
un moyen pour recevoir des segments de remplacement si un segment, ou plus, dudit logiciel d'exploitation n'a pas été reçu de façon valide. 30
19. Le convertisseur tel que défini dans l'une des revendications 17 ou 18 comprenant de plus :
un moyen pour empêcher la réception dudit logiciel d'exploitation si le nombre de segments identifiés par lesdites instructions est supérieur à une limite prédéterminée. 35
20. Appareil pour tête de réseau de télévision par câble pour télécharger un logiciel d'exploitation sur un convertisseur adressable de télévision par câble modifiable à distance (40), comprenant :
un moyen (26) pour transmettre des données de contrôle de convertisseur adressable sur 40

une fréquence porteuse d'une première voie de transmission de données d'un câble de distribution (36) d'un réseau de télévision par câble ;

un moyen (24) pour transmettre un logiciel d'exploitation sur une fréquence porteuse d'une seconde voie de transmission de données du câble de distribution (36) dudit réseau de télévision par câble ;

un moyen (14) pour fournir, dans lesdites données de contrôle de convertisseur adressable, une adresse spécifique à un convertisseur particulier (40) couplé au réseau, ladite adresse permettant audit convertisseur (40) de recevoir des données spécifiques sur ladite première voie de transmission de données ; et

un moyen (50) pour fournir des instructions dans lesdites données spécifiques, lesdites instructions amenant ledit convertisseur à commuter de ladite fréquence porteuse de ladite première voie de transmission sur ladite fréquence porteuse de ladite seconde voie de transmission afin de recevoir le logiciel d'exploitation transmis sur ladite seconde voie de transmission.

21. L'appareil de la revendication 20 comprenant de plus :

un moyen pour vérifier que le logiciel d'exploitation téléchargé sur ledit convertisseur a été reçu avec succès par le convertisseur.

22. L'appareil tel que défini dans l'une des revendications 20 ou 21 comprenant de plus :

un moyen de listage pour tenir un état des fonctions que ledit convertisseur est autorisé à avoir et pour attribuer, sur la base des fonctions autorisées, un progiciel d'exploitation particulier devant être téléchargé sur ledit convertisseur.

23. Un procédé pour fournir à un convertisseur adressable de télévision par câble des fonctions dictées par le logiciel d'exploitation téléchargé, comprenant les étapes consistant :

à recevoir des données de contrôle de convertisseur adressable depuis un emplacement de tête de réseau à distance sur une première voie de transmission d'un câble de distribution ;

à commuter ledit moyen récepteur de données (52) d'une fréquence porteuse de ladite première voie de transmission sur une fréquence porteuse d'une seconde voie de transmission en réponse à des instructions contenues dans lesdites données de contrôle de convertisseur

adressable ;

à capturer un progiciel d'exploitation désigné dans un ensemble de progiciels d'exploitation transmis depuis ledit emplacement de tête de réseau à distance sur ladite seconde voie de transmission du câble de distribution en réponse à des instructions contenues dans lesdites données de contrôle de convertisseur adressable ;

à mémoriser le progiciel d'exploitation désigné reçu sur ladite seconde voie de transmission dans une mémoire dont est muni ledit convertisseur ; et

à exécuter ledit logiciel d'exploitation afin de fournir au moins une fonction de convertisseur dictée de ce fait.

24. Le procédé de la revendication 23 dans lequel les progiciels d'exploitation sont transmis sous forme encryptée, ledit procédé comprenant l'étape supplémentaire consistant à :

décrypter le logiciel d'exploitation capturé en utilisant une clé contenue dans lesdites données de contrôle de convertisseur.

25. Le procédé de la revendication 23 ou de la revendication 24 comprenant les étapes supplémentaires consistant :

à surveiller ladite première voie de transmission afin de recevoir lesdites données de contrôle de convertisseur adressable ;

à commuter sur ladite seconde voie de transmission, après réception d'instructions appropriées sur ladite première voie de transmission, afin de capturer ledit logiciel d'exploitation ; et

à commuter en retour sur ladite première voie de transmission une

fois ledit logiciel d'exploitation capturé.

26. Le procédé de la revendication 25 comprenant l'étape supplémentaire consistant à :

commuter en retour de ladite seconde voie de transmission sur ladite première voie de transmission après expiration d'un laps de temps prédéterminé si le logiciel d'exploitation n'a pas été capturé dans ledit laps de temps.

27. Le procédé de la revendication 26 comprenant l'étape supplémentaire consistant à :

trouver ledit laps de temps dans lesdites données de contrôle de convertisseur adressable re-

ques sur ladite première voie de transmission.

28. Le procédé tel que défini dans l'une des revendications 26 ou 27 dans lequel la durée du laps de temps est fonction de la taille dudit logiciel d'exploitation devant être capturé. 5
29. Un terminal utilisateur modifiable à distance sous la forme d'un convertisseur de télévision par câble selon l'une des revendications 1 à 19, ledit terminal utilisateur comprenant : 10
- un moyen pour recevoir une pluralité de segments de logiciel d'exploitation transmis de façon cyclique formant ensemble un progiciel d'exploitation ; 15
 - un moyen couplé audit moyen récepteur pour vérifier chaque segment après sa réception ; 20
 - un moyen sensible audit moyen vérificateur pour mémoriser chaque segment vérifié ; 25
 - un moyen pour déterminer si un progiciel d'exploitation au complet a été mémorisé dans ledit moyen de mémorisation à la fin d'un cycle de transmission de logiciel d'exploitation ; 30
 - un moyen sensible audit moyen de détermination pour continuer de recevoir, vérifier et mémoriser des segments de logiciel d'exploitation transmis durant un cycle de transmission de logiciel d'exploitation ultérieur si ledit moyen de détermination constate qu'un progiciel d'exploitation au complet n'a pas été mémorisé ; et 35
 - un moyen pour interrompre la réception desdits segments de logiciel d'exploitation après constat, par ledit moyen de détermination, qu'un progiciel d'exploitation au complet a été mémorisé. 40
30. Le terminal de la revendication 29 comprenant de plus : 45
- un moyen pour prévenir l'exécution desdits segments de logiciel d'exploitation tant qu'un progiciel d'exploitation au complet n'a pas été mémorisé.
31. Le terminal tel que défini dans l'une des revendications 29 ou 30 dans lequel ledit moyen vérificateur examine, pour chaque segment de logiciel d'exploitation, une somme de contrôle, ledit terminal comprenant de plus : 50
- un moyen pour tenir un état de la somme de contrôle propre pour chaque segment ; et 55
 - un moyen pour ré-examiner périodiquement lesdites sommes de contrôle une fois qu'un

progiciel d'exploitation au complet a été mémorisé.

32. Le terminal de la revendication 31 comprenant de plus :

- un moyen pour mémoriser un logiciel d'exploitation par défaut pour ledit terminal ; et

- un moyen pour exécuter ledit logiciel d'exploitation par défaut si lesdites sommes de contrôle ne se sont pas vérifiées après avoir été ré-examinées.

33. Le terminal tel que défini dans l'une des revendications 29 à 32 comprenant de plus :

- un moyen pour valider le progiciel d'exploitation au complet une fois qu'il a été mémorisé.

34. Le terminal de la revendication 33 comprenant de plus :

- un moyen pour mémoriser un logiciel d'exploitation par défaut pour ledit terminal ; et

- un moyen pour exécuter ledit logiciel d'exploitation par défaut si ledit moyen de validation détermine que le progiciel d'exploitation au complet n'est pas valide.

35. Le terminal tel que défini dans l'une des revendications 29 à 34 comprenant de plus :

- un moyen minuteur pour interrompre la réception de segments de logiciel d'exploitation une fois un laps de temps prédéterminé écoulé.

36. Le terminal de la revendication 35 comprenant de plus :

- un moyen pour mémoriser un logiciel d'exploitation par défaut pour ledit terminal ; et

- un moyen pour exécuter ledit logiciel d'exploitation par défaut si ledit moyen minuteur interrompt la réception desdits segments de logiciel d'exploitation.

37. Le terminal tel que défini dans l'une des revendications 29 à 36 dans lequel l'exécution dudit logiciel d'exploitation fournit au moins une fonction de convertisseur du convertisseur de télévision par câble.

38. Le terminal tel que défini dans l'une des revendications 29 à 37 dans lequel un progiciel d'exploitation au complet comporte une pluralité de modules, ledit terminal comprenant de plus :

- un moyen pour prévenir l'exécution d'un logi-

ciel d'exploitation téléchargé si les modules ne sont pas tous disponibles pour l'exécution.

39. Procédé pour fournir un logiciel d'exploitation téléchargé à un convertisseur adressable de télévision par câble modifiable à distance grâce à un appareil de tête de réseau de télévision par câble, comprenant les étapes consistant :
- à transmettre des données de contrôle de convertisseur adressable sur une fréquence porteuse d'une première voie de transmission de données d'un câble de distribution d'un réseau de télévision par câble ; 10
- à transmettre ledit logiciel d'exploitation sur une fréquence porteuse d'une seconde voie de transmission de données du câble de distribution dudit réseau de télévision par câble ; 15
- à fournir, dans lesdites données de contrôle de convertisseur adressable, une adresse spécifique à un convertisseur particulier couplé au réseau, ladite adresse permettant audit convertisseur de recevoir des données spécifiques sur ladite première voie de transmission de données ; et 20
- à fournir des instructions dans lesdites données spécifiques, lesdites instructions amenant ledit convertisseur à commuter de ladite fréquence porteuse de ladite première voie de transmission sur ladite fréquence porteuse de ladite seconde voie de transmission afin de recevoir ledit logiciel d'exploitation transmis sur ladite seconde voie de transmission. 25 30 35

40

45

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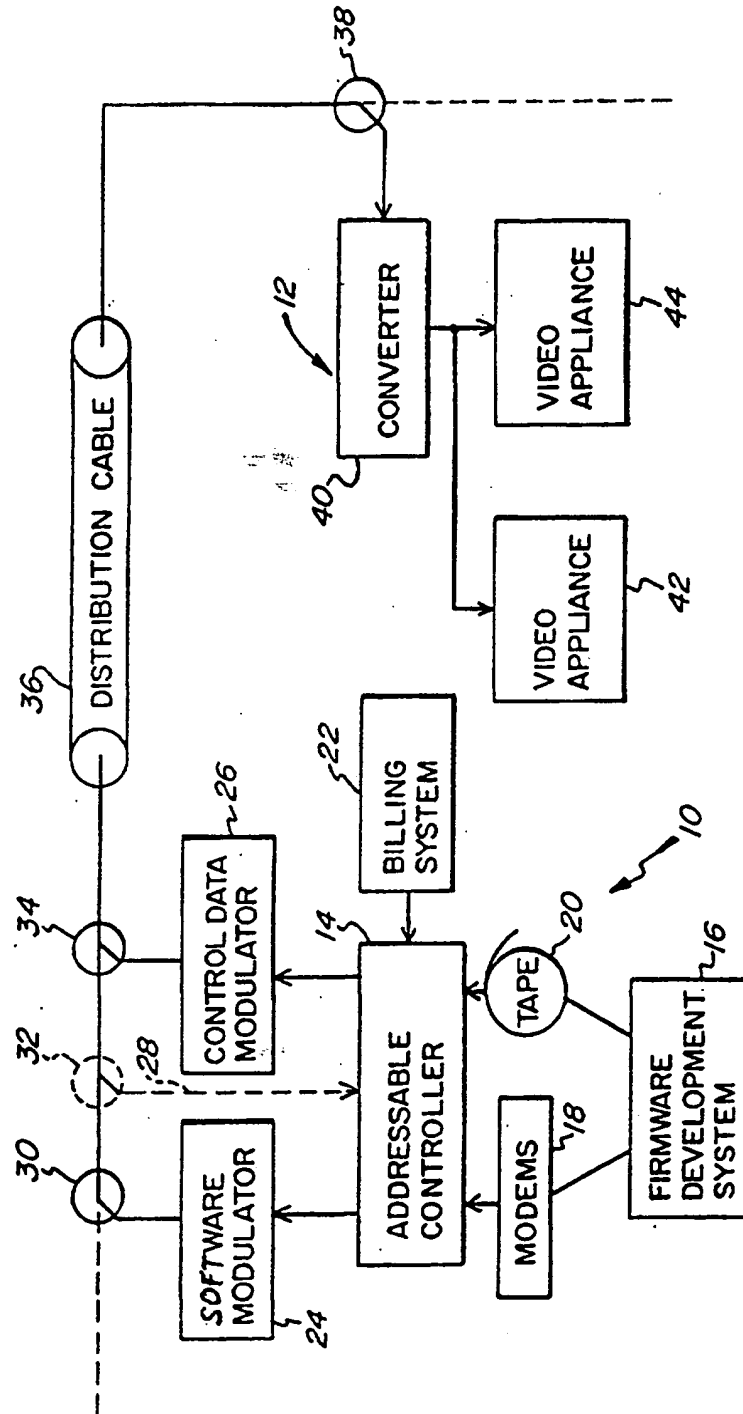
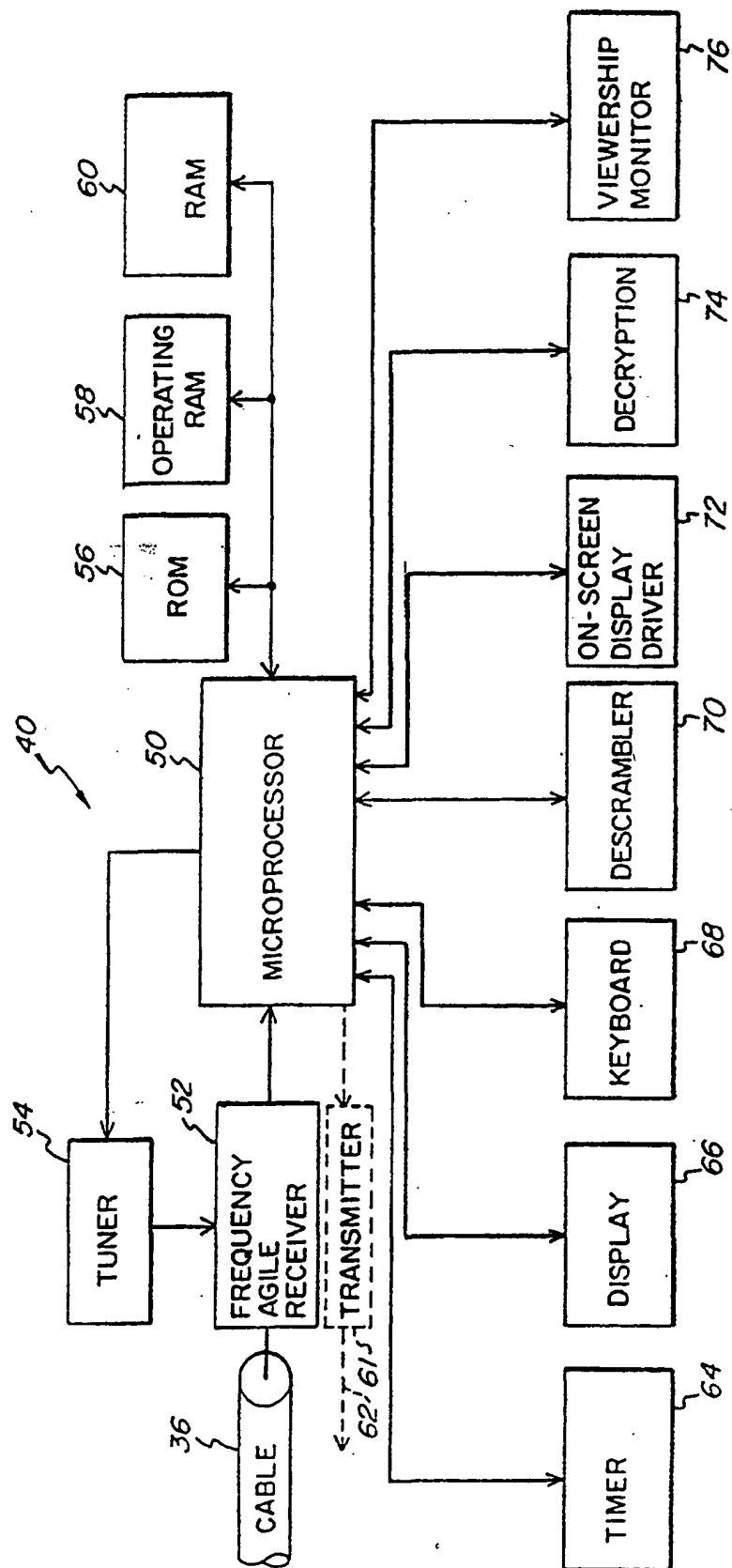
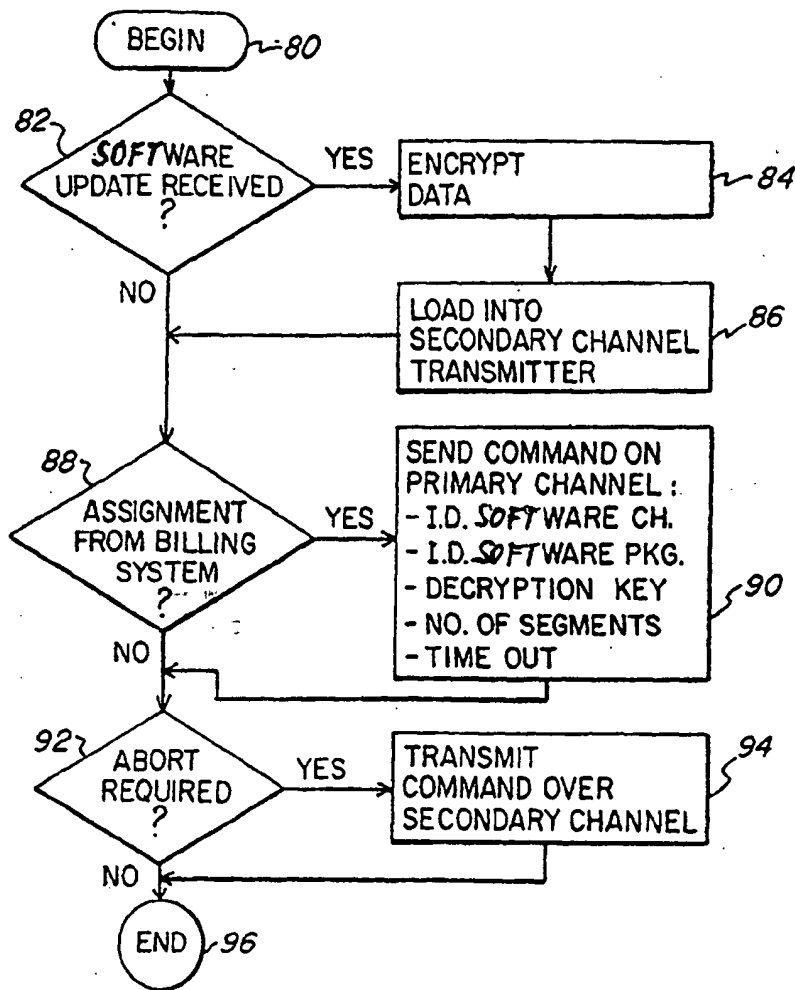
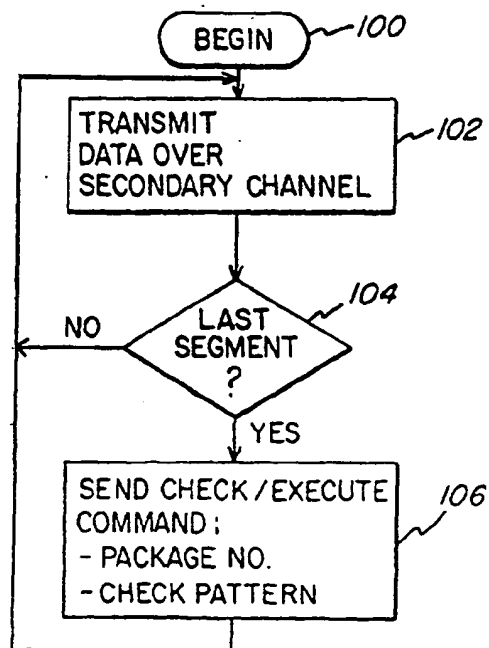
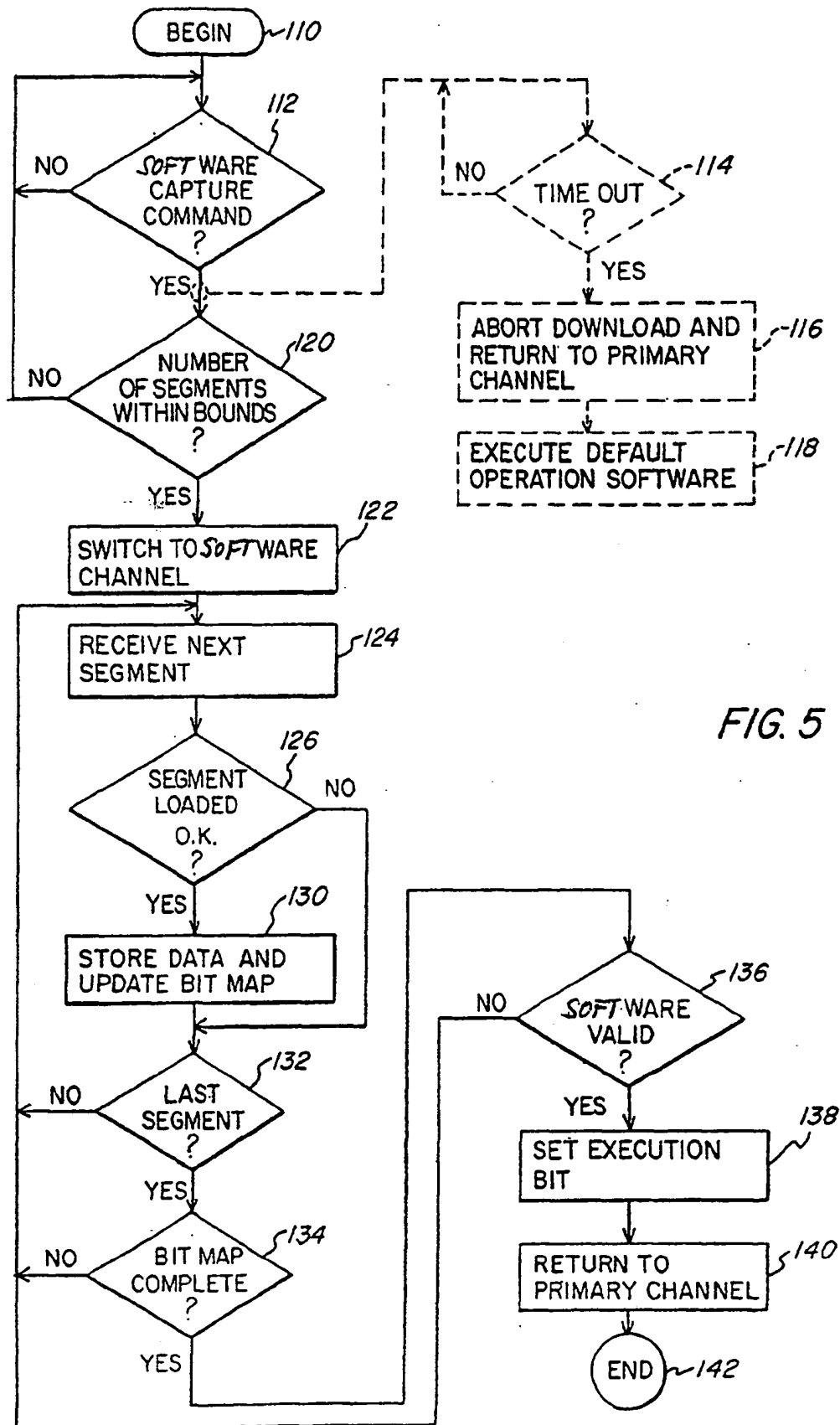


FIG. 1

FIG. 2



**FIG. 4**



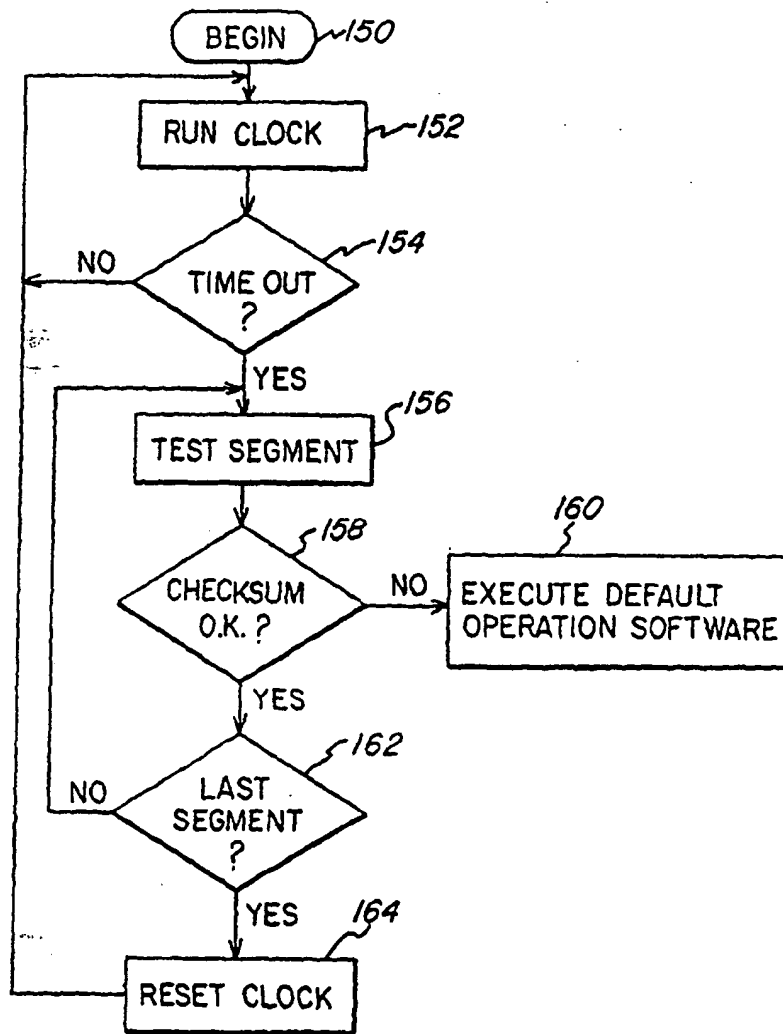


FIG. 6